Development and Validation of the Accessibility of Campus Computing for Students With Disabilities Scale: Service Providers' Perspective

Myrtis E. Fossey
Jennison V. Asuncion
Catherine Fichten
Chantal Robillard
Maria Barile
Rhonda Amsel
Fran Prezant
Stephen Morabito

Dawson College, Concordia University, McGill University, Université de Montréal, National Center for Disability Services

Abstract

Responses by 156 Canadian college and university professionals who provide disability-related services to students were used to construct, develop, and validate the Accessibility of Campus Computing for Students With Disabilities Scale (ACCSDS): Service Provider Version. This is a 19-item, self-administered tool that evaluates institutional computing accessibility for students with disabilities from the perspective of disability service providers. The measure contains 4 empirically derived subscales: Access to Adaptive Computers, Infrastructure and Collaboration, Academic Inclusion, and Adaptive Technology Competence. Results indicate that these 4 factors account for 54% of the variability in total scores. The data also show good internal consistency for the subscales and the full scale. Data concerning validity show strong relationships between scores and a key criterion variable. The ACCSDS can be used to evaluate disability service providers' views about an institution's technology accessibility, to provide empirical data to influence information and instructional technology policy, and to pinpoint areas of strength as well as areas needing improvement.

The integration of educational technologies with campus computing infrastructure is an ongoing activity on North American campuses (e.g., Educause, 2002; Green, 2003; Harler, 2000; Kiernan, 2002). Ongoing evaluation of the ability of these technologies to meet the needs of students, faculty, and other institutional constituencies is an important aspect of this integration (e.g., Educause, 2004). Evaluation is necessary for a variety of reasons that include ensuring a return on investment, measuring penetration and acceptance, and pinpointing areas for improvement (Bullock & Ory, 2000). Institutions' computer technologies for students with disabilities has been a neglected topic in such evaluations. The scale developed and validated from this investigation, the Accessibility of Campus Computing for Students With Disabilities Scale (ACCSDS): Service Provider Version, was designed to partially fill this gap.

Accessibility of Campus Computing to Students With Disabilities

Between 5% and 11% of students attending North American postsecondary education institutions have a disability (cf. Fichten, et al. 2003; National Center for

Education Statistics, 2002). Both government legislation (e.g., Americans with Disabilities Act, 1990; Australia's Disability Discrimination Act, 1992), as well as the promotion of best practices (e.g., High Tech Center Training Unit, 1999; Quality and Standards in Higher Education, 1999), speak to the need for equal access to education for individuals with disabilities. This emphasizes the utility and timeliness of a tool to assess the campus-based disability service providers' perceptions about how the computer-related needs of students with disabilities are being met .

Undertaking an institutional assessment of perceptions about how well the computing needs of students with disabilities are being met requires the vantage points of many constituencies. Of course, the students' viewpoints lead to an understanding of whether campus computing is accessible or not. The perspective of campus-based disability service providers is also essential because these individuals are ideally positioned to evaluate aspects of access to campus computing that students may not be aware of. For example, the perspective of students is that of the end-users. Moreover, students are usually unaware of disabilities that are different from theirs (Fichten, Robillard, Tagalakis, & Amsel, 1991). Campus-based disability service providers often have an informed institutional view of what administrative, policy, and other factors are at play when it comes to disability-related issues. Therefore, as a starting point, we focused on developing a tool that can be used by the campus-based professionals who are accountable for delivering disability-related support to students.

The Association on Higher Education And Disability (AHEAD), the professional organization to which many of these individuals belong, estimates that approximately half of the approximately 5,000 higher education institutions in the United States have at least one individual designated to support students with disabilities (Michaels et al., 2001). In many cases, addressing the computer technology needs of these students on campus has become part of the disability service provider's job description. For example, our data indicate that these individuals recognize computer-related services as one of the priority services they deliver to students with disabilities (Fichten, et al., 2004). Thus, the viewpoint of the professionals who provide disability-related services is very important, in part because they are best suited to lead, not necessarily in isolation, any efforts around this type of assessment.

Institutional Assessment of Accessibility

One difficulty in conducting institutional evaluation of the accessibility of campus computing to students with disabilities has been a lack of suitable assessment instruments. There have been several studies that evaluate the campus computing needs of postsecondary students with disabilities in the U.S. (e.g., Burgstahler, 1992, 1993; Burris, 1998; Coomber, 1996; Horn & Shell, 1990; Jackson et al., 2001; Lance, 1996) and Canada (Epp, 1996; Killean & Hubka, 1999) that dealt, in part, with the views of professionals who provide on-campus disability-related supports in higher education around access to campus computing. However, none of these studies have developed a valid, easy-to-administer, self-evaluation tool specifically geared toward examining the accessibility of campus computing.

It was only when we turned to the non-disability literature that we found work with a specific focus on assessing the current state of campus computing (for the U.S., see Green, 2000; 2001; 2003; for Canada, see Campbell, 2001). Such measures, however, do not include indicators that measure aspects of access to campus computing by individuals with disabilities.

Present Investigation

The goal of this investigation was to provide a valid tool for the professionals who provide disability-related supports on campus. The measure had to meet the following criteria: easy for campus-based disability service providers to answer questions; adaptable to the changing landscape of campus computing; meaningful to administration in assisting them in making new educational technologies accessible; and helpful as a tool to advocate with college bodies to sensitize them to the importance of making information and instructional technologies accessible to all students, including those with disabilities. Accessibility, in this context, refers to a range of situations such as whether there are computers with adaptive technologies (e.g., software that speaks what is written on the screen, adaptive mouse) in general-use computer labs; whether personnel who provide services to students with disabilities on campus are consulted when computer infrastructure decisions are made; and whether computer-based learning materials used by faculty (e.g., course Web pages) meet accessibility guidelines. In exploring institutional accessibility and developing a measure to evaluate it, one question dominated the process: What makes educational institutions technologically accessible to students with disabilities? To answer this question when developing the measure,

we focused on aspects of accessibility that predict how well the computer-related needs of students with disabilities are seen to be met by campus-based disability service providers.

Method

Participants

The participants were 156 postsecondary personnel responsible for providing services to students with disabilities (110 females and 46 males). All were enrolled in a larger investigation of the computing and technological needs of students with disabilities (cf. Fichten, et al., 2003; 2004). Ninety-six participants worked at a college, 58 worked at a university, and 2 were at a postsecondary distance-education institution (1 college and 1 university). Overall, participants had worked an average of 9 years providing services to students with disabilities (range <1 to 26). Canada is a bilingual country, and 116 (74%) of respondents represented English-speaking institutions; 39 (25%) represented French-speaking institutions; and 1(1%) represented a bilingual institution. Participants represented 91 of the 115 colleges and 55 of the 68 universities that were listed on the Web pages of the Association of Community Colleges of Canada (ACCC) or the Association of Universities and Colleges of Canada (AUCC) on April 22, 2000. Whenever an institution was a member of both ACCC and AUCC, the institution was counted as a college rather than a university. The overall participation rate was 80%—79% participation from the colleges, 81% from universities, and 67% from postsecondary distance education institutions. Additional details about the sample are available in Fichten et al. (2001, 2004).

Procedure

To recruit participants, we attempted to contact by telephone, members of the AUCC and the ACCC (i.e., those institutions listed on these organizations' Web sites as of April 22, 2000). We asked to speak to the person responsible for providing services to students with disabilities. Potential participants at the 183 eligible institutions were asked to volunteer. An English-speaking researcher contacted Anglophone institutions , and a French-speaking researcher contacted Francophone institutions. Bilingual institutions were contacted in either language. A time was scheduled for those who agreed to be interviewed. All interviews were conducted by telephone during spring 2000.

Ethical considerations. An informed consent form was sent by email or fax to potential respondents, which indicated the goals of the project, the risks envisaged, the right to withdraw at any time without penalty, and the precautions taken to ensure confidentiality. To encourage honest responses among those answers that might not reflect well on respondents' educational institutions, participants were assured that the information that they provided would never be linked either to themselves or to their educational institution.

Structured interview questions. For the purposes of the larger study, 60 items, including demographic questions, were administered (questions available in Fichten, et al., 2001). Of interest to the present investigation are the 23, 6-point Likert-scaled items (range: strongly agree to strongly disagree), which inquired about the actual situation at a respondent's institution, campus, or sector. Items were generally positively worded, described a set of conditions at the institution (e.g., computer equipment is up to date), and stated that the characteristic met the needs of students with disabilities (e.g., "At my institution, computer and/or adaptive computer technologies are sufficiently up to date to meet the needs of students with disabilities"). These items were designed to assess the perceptions of participants regarding the adequacy of campus-based computer technologies, resources, training, policies, personnel, services, and the adequacy of rehabilitation-sector support to meet the needs of students with disabilities. A key criterion inquired, using a 6-point Likert scale, about the participant's evaluation of how well, overall, the computer and/or adaptive computer and technology needs of students with disabilities were being met at the respondent's institution.

Of the 23 items originally included in the development of the scale, only 19 were retained. Two items were dropped because the number of respondents who answered these two questions was too low for inclusion in the factor analysis. Those items dealt with equipment loan programs and with Internet-based distance education. Two other items were dropped because they dealt with off-campus issues related to community-based rehabilitation agencies. While important, these latter two items are not, strictly speaking, campus computing issues. All four of these items, however, were found to correlate well with the criterion variable. Therefore, we included them at the end of the measure as extra items that would in the future allow for a more comprehensive evaluation of the elements important in ensuring good access to computers for students with disabilities (see measure in Appendix).

Table 1

ACCSDS: Service Provider Version - Factor Loadings of Each Item Following Varimax Rotation

Items	Factor 1	Factor 2	Factor 3	Factor 4
1. At my institution, computer and/or adaptive computer technologies are sufficiently up to date to meet the needs of students with disabilities	0.727	-0.137	0.127	0.265
2. At my institution, the hours of access to adaptive computer technologies meet the needs of students with disabilities	0.629	0.230	0.099	-0.042
3. At my institution, there are enough computers with Internet access that also have adaptive hardware/software on them to meet the needs of students with disabilities	0.782	0.090	0.268	0.066
4. The technical support at my institution for students using adaptive computer technologies meets the needs of students with disabilities	0.556	0.491	0.014	0.337
5. The availability of adaptive computer technologies in specialized labs/centers for students with disabilities at my institution meets their needs	0.761	0.085	0.176	0.073
6. The training provided by my institution on adaptive computer technologies for students with disabilities meets their needs	0.550	0.347	0.076	0.275
7. The physical space available for adaptive computer technologies at my institution meets the needs of students with disabilities	0.544	0.583	-0.014	-0.100
8. I am (my office/service is) consulted when major campus-wide computer infrastructure decisions are made (e.g., purchasing institution-wide software, Web design, adding or improving computer labs)	0.033	0.595	0.299	0.082
9. My institution has an advisory/steering committee that deals with the accessibility of computer technologies for students with disabilities	0.090	0.399	0.018	0.187
10. The administration reacts positively when I approach them with problems related to the accessibility of computers on campus for students with disabilities	0.113	0.677	0.222	0.091
11. Personnel who take care of mainstream computers on campus have the expertise to deal with adaptive computer technologies	0.113	0.609	0.039	0.001
12. Accessibility issues are covered when faculty are trained in how to use computer technologies in their courses	-0.136	0.450	0.435	0.257
13. The funding for my institution's computer and/or adaptive computer technologies (from my institution, government, programs, agencies, foundations, companies) meets the needs of students with disabilities	0.470	0.038	0.616	0.002
14. The availability of adaptive computer technologies in mainstream computer labs at my institution meets the needs of students with disabilities	0.202	0.345	0.595	-0.069
15. The accessibility of computer-based teaching materials used by professors (e.g., math software, CD-ROMs, Web pages) meets the needs of students with disabilities	0.151	0.334	0.600	0.101
16. The accessibility of the library's computers (e.g., computerized catalogues, databases, CD-ROMs) meets the needs of students with disabilities	0.135	-0.040	0.711	-0.065
17. There are opportunities for employees of my institution to learn about adaptive computer technologies	0.112	0.246	0.069	0.741
18. There is a person at my institution who has expertise in adaptive computer technologies (i.e., someone who is knowledgeable, keeps up to date with new products, and fixes hardware and software problems)	0.226	0.282	-0.144	0.620
19. I am knowledgeable about adaptive computer technologies	0.037	-0.098	0.035	0.790

Table 2

ACCSDS: Service Provider Version—Means, Standard Deviations, and Cronbach Alpha Reliability Scores

Subscales	Mean	Standard Deviation	Cronbach's Alpha
1. Access to adaptive computers	3.77	1.22	.85
2. Infrastructure and collaboration	3.02	1.13	.71
3. Academic inclusion	2.96	1.13	.73
4. Adaptive technology competence	3.33	1.32	.66
Total scale	3.31	0.83	.89

Results

A 4-factor solution shows that principal components analysis, with varimax rotation, explained a cumulative 54% of the variability in scores. Factor 1, which measures access to adaptive computers, explained 28.9% of the variability. Factor 2, which measures infrastructure and collaboration, explained an additional 9.6%. Factor 3, which measures academic inclusion explained a further 9.2%; and Factor 4, which assesses adaptive technology competence, explained the remaining 6.1%. Table 1 presents the rotated factors with the factor loading for each item. Items were assigned to the factor corresponding to the highest factor loading.

Despite some of the factor loadings being rather low (e.g., see item 12), it can be seen in Table 2 that the alpha coefficients for the four factors as well as for the full scale were satisfactory, and the removal of any item would not greatly affect alpha. These, as well as means and standard deviations, are presented in Table 2.

Access to adaptive computers. This subscale evaluates service providers' perceptions about the extent to which computers with adaptive hardware and software are available on campus as well as aspects of technical support and training on these technologies within the institution.

Infrastructure and collaboration. This subscale evaluates service providers' perceptions about the extent to which the institution's information technology infrastructure is accessible as well as aspects of the overall cooperativeness of other departments within the institution with respect to issues of access to campus computing.

Academic inclusion. This subscale evaluates service providers' perceptions about the extent to which an institution is academically inclusive of students with disabilities in terms of funding, mainstreaming of adaptive equipment, and awareness and training of faculty members with respect to accessibility of computer-based teaching materials.

Adaptive technology competence. This subscale evaluates service providers' perceptions about the extent to which an institution has access to technical support and whether it fosters knowledge about adaptive computer technologies on campus.

Scoring, Norms, Validation, and Standardization

The four factors were moderately correlated with one another (range r = 0.15 to r = 0.58). Coefficients are available in Table 3. These internal-validity correlation coefficients show strong relationships between subscale scores and the full-scale score (range from r =. 58 to r =. 86). The coefficients in Table 3 indicate that the subscales are measuring different concepts, all of which are important components of the concept measured by the full scale.

Because all items use a 6-point scale, both subscale and total scores were computed by taking the mean of the items that comprise the subscale. This is also true for full scale scores. Thus all scores vary between 1 and 6, with higher scores representing a perception of better access to campus computer technologies.

Table 3

ACCSDS: Service Provider Version - Correlations of Subscale Scores to Each Other and to Full Scale Score

	1. Access to Adaptive Computers	2. Infrastructure and Collaboration	3. Academic Inclusion	4. Adaptive Technology Competence
1. Access to Adaptive Computers				
2. Infrastructure and Collaboration	.50			
3. Academic Inclusion	.58	.43		
4. Adaptive Technology Competence	.46	.36	.15	
Total Scale	.86	.77	.74	.58

Table 4

ACCSDS: Service Provider Version - Correlations of Subscales and Full Scale Score to Criterion

	Criterion
Subscales	
1. Access to Adaptive Computers	.64
2. Infrastructure and Collaboration	.20
3. Academic Inclusion	.47
4. Adaptive Technology Competence	.35
Total Scale	.55

Correlations with the criterion variable, "*Overall, the computer and/or adaptive computer technology needs of students with disabilities at my institution are adequately met,*" are presented in Table 4. Results show moderate correlations between the subscales and the criterion variable (range from r =.20 to r =.64) as well as a moderate correlation between the full scale score and the criterion variable (r =.55). Subscales 1, 3, and 4 as well as the full scale score are likely the best indicators of how well students' computer-related needs are met on campus.

Discussion

The findings (a) provide a scale that has demonstrated reliability and validity for the evaluation of campus-based disability service providers' views about the accessibility of campus computing for students with disabilities; and (b) underscore the concept that good access to campus computing is a matter of having good support systems in place to help computer users, a firm commitment to accommodating special needs of students, and a desire to keep up to date with advances in technology.

Meeting the Computer-Related Needs of Students With Disabilities

The answer to our initial research question, "What are the predictors of how well the computer-related needs of students with disabilities are being met on campus, as perceived by campus-based disability service providers?" is undoubtedly a combination of many variables that have yet to be touched on in this paper or in the literature to date. Nevertheless, the present investigation suggests that the 19 items of the ACCSDS: Service Provider Version measure developed here as well as the four additional items (see Appendix) provide an important part of the answer to this question. Correlations between subscale scores and scores on the criterion variable, "*Overall, the computer and/or adaptive computer technology needs of students with disabilities at my institution are adequately met,*" suggest that the best predictors of how well the computer-related needs of students with disabilities are met from the vantage point of disability service providers are the concepts embodied in the four subscales: (a) access to adaptive computers, (b) good institutional infrastructure and departmental collaboration, (c) academic inclusion, and (d) competence in adaptive technologies. Indeed, the findings show that institutions scoring in the higher range of meeting computer-related needs of students with disabilities had the following: the best availability of cutting-edge, adaptive computer technologies for students with disabilities; excellent technical support and available expertise regarding adaptive computer technologies; the best available training for student faculty and staff in adaptive computer technologies; inclusive infrastructures; a cooperative administration; accessible teaching and library computer-based teaching materials; and adequate funding for adaptive computer technologies and training.

Uses of the Accessibility of Campus Computing for Students With Disabilities Scale (ACCSDS): Service Provider Version

The ACCSDS: Service Provider Version is meant to be completed by campus-based disability service providers. It has been normed on 80% of the Canadian population of campus-based disability service providers. Thus, our sample is truly representative of the geographic, linguistic, and institutional characteristics of the Canadian postsecondary education system. The scale has also been shown to have demonstrated validity and reliability. However, it should be noted that test-retest reliability was not assessed and the sensitivity of the measure has not been evaluated. Also, this measure was developed on a Canadian sample, and it has not been administered to a second sample to provide additional validation. Furthermore, the validity of this measure for other populations has not been assessed. Additional validation of the scale is necessary.

Nevertheless, the scale has a variety of attractive features. It is one page in length, designed for self-administration by campus-based disability service providers, and available in French and English. Scoring is simple, and requires only the straightforward calculation of five averages. This measure also has the advantage of flexibility due to its "face validity." Thus, the scale permits item-by-item analysis, if needed, to identify individual areas of perceived strength and weakness. It can both assess modifiable aspects of access to campus computing as well as monitor and evaluate the effects of various efforts to improve access. For example, the measure could be administered at various times while major modifications are made to campus computing infrastructure. Potential uses of the scale include: (a) evaluation of one's own institution, (b) measuring progress, (c) item-by-item evaluation, (d) comparison with similar institutions, (e) targeting areas for improvement, (f) formative evaluation, (g) basis for policy documents, (h) basis for institutional changes, and (i) basis for budget allocation.

As the first step in addressing the evaluation of computer accessibility to students with disabilities in postsecondary education, the ACCSDS: Service Provider Version fills an important void. This measure would, however, benefit from additional validation and norming. Possible research directions include: (a) continued validation by correlating scores from personnel responsible for providing services to students with disabilities with students' views, (b) additional reliability testing by conducting test-retest assessment, (c) additions to the normative data by providing separate norms

by language, size, nature (junior or community college vs. university) and location of institution, (d) new samples, including some from outside of Canada such as the U.S., Great Britain, or Australia, (e) modifications to enable individuals who provide disability-related services to students with disabilities to respond to questions based on accessibility for students with varying types of disabilities (e.g., students who are blind, students with hearing impairments) and, perhaps most important, (f) modifications to enable students with different disabilities to complete the scale. Research in our laboratory is ongoing to address some of these issues.

Conclusion

The trend toward increased integration of computer, information, and instructional technologies into the postsecondary curriculum shows no sign of abating in the near future as colleges and universities continue to experiment and to implement different forms of campus computing into their programs (e.g., Green, 2003; Twigg, 2001). Students with disabilities continue to enroll in higher education in record numbers (cf. Fichten, et al., 2003; National Center for Education Statistics, 2001; 2002). In addition, government and other agencies with influence over education are taking a proactive role in terms of informing schools of their obligation to provide education that is accessible to all learners (e.g., Grossman*, 2004; Simon & Grossman, 2004*). These trends make it vital that the accessibility of campus computing be evaluated and monitored to ensure that students with disabilities are not left behind.

The evaluation tool we propose here is a part, but not the whole, solution to the assessment of the accessibility of campus computing. Until a more comprehensive tool is developed, we propose that our measure be used by schools to gain a better understanding as to how they are doing when it comes to one component of ensuring education equity: campus computing accessible to all students. Indeed, the data gathered with the Accessibility of Campus Computing for Students With Disabilities Scale (ACCSDS): Service Provider Version can be used not only to highlight successes but also as a factual basis for improvement plans.

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Appendix

Accessibility of Campus Computing for Students With Disabilities Scale (ACCSDS): Service Provider Version

For all questions, rate your level of agreement using the following scale:

1 = Strongly Disagree, 2 = Moderately Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Moderately Agree, 6 = Strongly Agree

Do not spend too much time on any one statement. Simply give the answer which best describes the general situation. If an item is not applicable to your institution, respond with "N/A" (not applicable).

1. ____ At my institution, computer and/or adaptive computer technologies are sufficiently up-to-date to meet the needs of students with disabilities
2. ____ At my institution, the hours of access to adaptive computer technologies meet the needs of students with disabilities
3. ____ At my institution, there are enough computers with Internet access that also have adaptive hardware/software on them to meet the needs of students with disabilities
4. ____ The technical support at my institution for students using adaptive computer technologies meets the needs of students with disabilities
5. ____ The availability of adaptive computer technologies in specialized labs/centers for students with disabilities at my institution meets their needs
6. ____ The training provided by my institution on adaptive computer technologies for students with disabilities meets their needs

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7. ____ The physical space available for adaptive computer technologies at my institution meets the needs of students with disabilities
8. ____ I am (my office/service is) consulted when major campus-wide computer infrastructure decisions are made (e.g., purchasing institution-wide software, Web design, adding or improving computer labs)
9. ____ My institution has an advisory/steering committee that deals with the accessibility of computer technologies for students with disabilities
10. ___ The administration reacts positively when I approach them with problems related to the accessibility of computers on campus for students with disabilities
11. ___ Personnel who take care of mainstream computers on campus have the expertise to deal with adaptive computer technologies

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12. ___ Accessibility issues are covered when faculty are trained in how to use computer technologies in their courses
13. ___ The funding for my institution's computer and/or adaptive computer technologies (from my institution, government, programs, agencies, foundations, companies) meets the needs of students with disabilities
14. ___ The availability of adaptive computer technologies in mainstream computer labs at my institution meets the needs of students with disabilities
15. ___ The accessibility of computer-based teaching materials used by professors (e.g., math software, CD-ROMs, Web pages) meets the needs of students with disabilities
16. ___ The accessibility of the library's computers (e.g., computerized catalogues, databases, CD-ROMs) meets the needs of students with disabilities

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17. ___ There are opportunities for employees of my institution to learn about adaptive computer technologies
18. ___ There is a person at my institution who has expertise in adaptive computer technologies (i.e., someone who is knowledgeable, keeps up-to-date with new products, and fixes hardware and software problems)
19. ___ I am knowledgeable about adaptive computer technologies (e.g., software that enlarges what is on the screen, adapted mouse)

_____ **TOTAL SCALE SCORE** Average all scores for items 1 through 19

SUBSCALES

_____ **Access To Adaptive Computers Subscale Scoring** Average scores from items 1, 2, 3, 4, 5 and, 6
_____ **Infrastructure And Collaboration Subscale Scoring** Average scores from items 7, 8, 9, 10 and, 11
_____ **Academic Inclusion Subscale Scoring** Average scores from items 12, 13, 14, 15 and, 16
_____ **Adaptive Technology Competence Subscale Scoring** Average scores from items 17, 18 and, 19

EXTRA ITEMS

20. ___ My school's loan program of computer and/or adaptive computer technologies for off-campus use meets the needs of students with disabilities
21. ___ The accessibility of my institution's Internet-based distance education courses meets the needs of students with disabilities
22. ___ I have the sense that rehabilitation centers, programs, agencies, or companies that supply computer and/or adaptive computer technologies to students with disabilities provide appropriate software/hardware
23. ___ I have the sense that students with disabilities have received adequate training in using computer and/or adaptive computer technologies from rehabilitation centers, programs, agencies, companies, etc.